Abstract

A filtration module has a plurality of hollow fibre nanofiltration or reverse osmosis membranes suspended between a pair of opposed headers. The lumens of the membranes are the retentate or feed side. The membranes are arranged in groups, such as sectors of a cylinder, and form preceding or succeeding stages. A permeate collection plenum is in direct fluid communication with each stage. The stages are connected by caps typically having dividers located at the ends of the module. The module is used to filter water and, when optionally fitted with hollow fibre membranes adapted to selectively reject hardness causing salts, is used to remove hardness. Methods of cleaning using acidic solutions or gaseous carbon dioxide are discussed. Cleaning methods include adding acid to the feed water continuously or periodically during permeation, flushing the module with an acidic solution while not permeating and holding an acidic solution or gaseous carbon dioxide in the module for a period of time while not permeating followed by flushing. A filtration system is also disclosed.